NASA Related Research at UNM

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University of New Mexico

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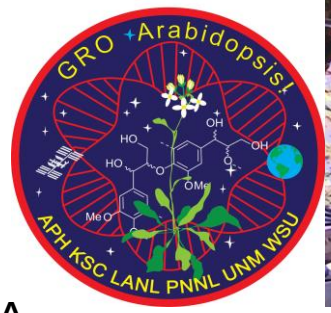
NASA Technology Infusion Road Tour in Las Cruces

Las Cruces , NM

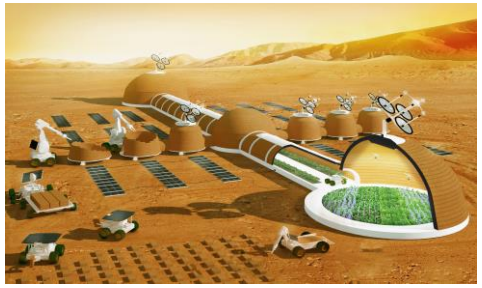
08/13/2019

UNM Biology: Extraterrestrial Botany Research and Education (Hanson)

Current NASA funding: Basic science examining Gravity Response Omics (GRO) for the model plant *Arabidopsis* as well as photosynthesis and anatomy in the first experiment in the Advanced Plant Habitat (APH) on the ISS.



Pending NASA funding: Cross-disciplinary NASA MIRO training grant (A&S, SOE, SA+P) with community colleges to develop skills needed for building and operating Life-supporting Extraterrestrial Automated Farming (LEAF) on the moon, Mars, and in space.

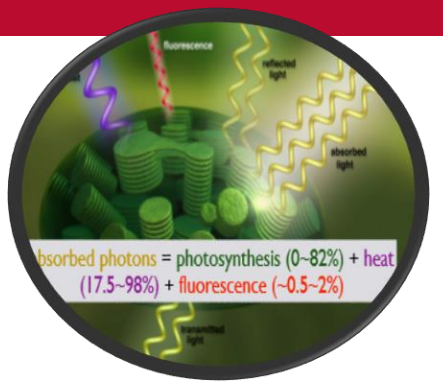


Past/soon to be submitted NASA funding: The NMSGC funded our pilot project for informal education classes at Explora on extraterrestrial botany. This was for 5th-8th grade students and in August, Explora will lead a new proposal to expand this to projects and exhibits relating to growing food on the moon and Mars.

NASA funded research: Marcy Litvak

Current:

Chlorophyll Fluorescence and Soil Moisture Observations to Characterize Terrestrial Vegetation Photosynthesis and Biosphere Carbon Uptake in North America. Funded through ROSES 2016 A.28. *Uses NASA observational, modeling and data assimilation tools, and flux towers to help refine estimates of carbon flux at regional to continental scales, and advance a more mechanistic understanding of carbon-water cycle links*



Past:

Improving the Estimation of Carbon Stocks and Fluxes in Semi-arid Ecosystems of the Southwestern US using full-waveform lidar measurements. Funded through ROSES 2010. *Used flux towers, direct measurements of ecosystem structure using lidar and data assimilation to improve our knowledge of dryland carbon fluxes in this region.*

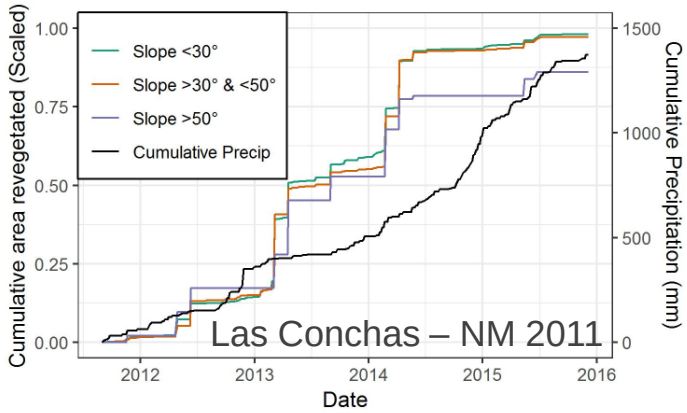
Investigating controls and constraints on light-use efficiency across the semi-arid Southwest. NASA New Mexico Space Grant Consortium award to former grad Student, Dan Krofcheck. *Used flux towers, satellite observations and field measurements to understand how piñon mortality alters the ability of piñon-juniper woodlands to use light*

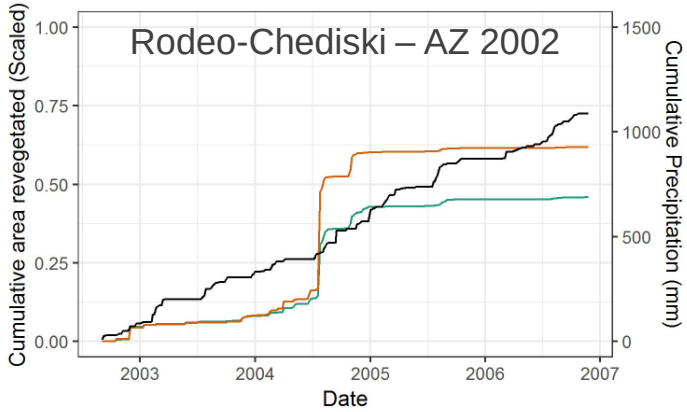
Pending:

Terrestrial carbon uptake in a drier world: Improved understanding of water limitation impacts across drylands of North America. Submitted to recent NASA Ecostress RFP. *Will use NASA ECOSTRESS, OCO-3 missions, archived MODIS, VIIRS, OCO-2, AMSR-E, SMAP, GRACE data archives and flux towers to increase our understanding of how water stress will impact the carbon cycle.*

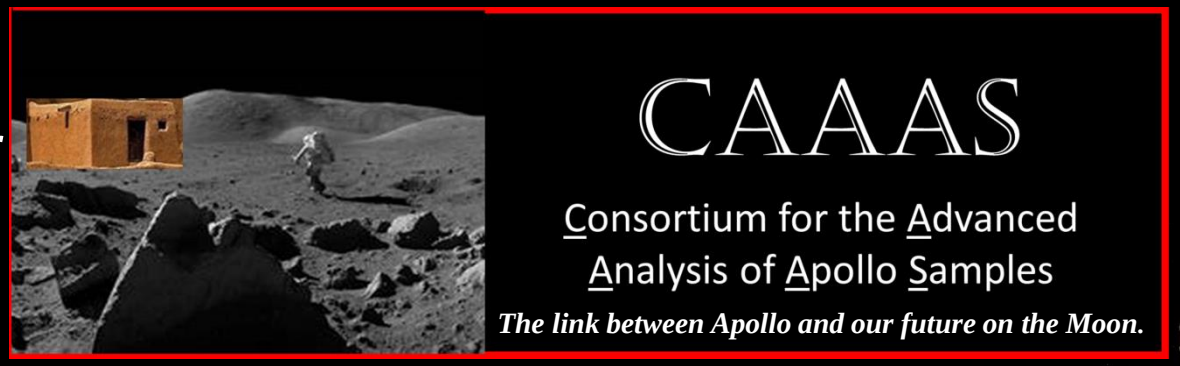
UNM Biology: Quantifying the physical controls on post-wildfire vegetation establishment in the southwestern US (Hurteau)

- Ground cover stabilizes soils after severe forest fires, but erosion can remove soils and slow revegetation
- Using merged MODIS/Landsat datasets, I am investigating how intense precipitation and topography has slowed revegetation
- Initial results indicate the interaction of precipitation intensity and slope steepness influence the rate of green-up



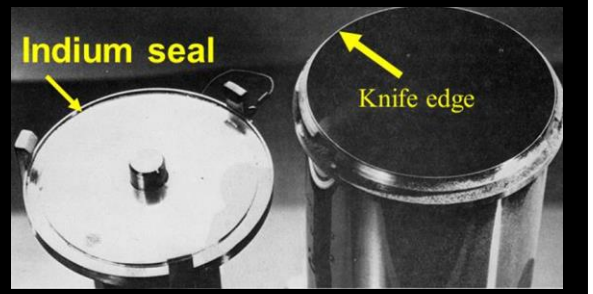


CAAAS P.I.
Charles Shearer
IOM and E&PS
UNM



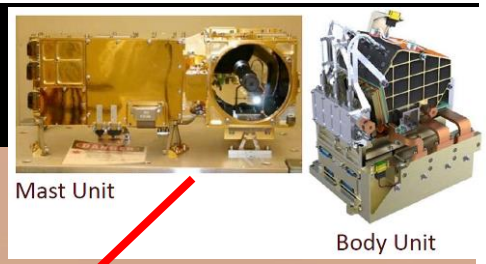
- One of 9 teams selected for NASA's ANGSA (Apollo Next Generation Sample Analysis) Program.
- A UNM-led science & engineering consortium.
- The CAAAS team will examine unopened, pristine lunar samples collected by the Apollo program.
- CAAAS will Identify lunar volatile resources for future human activity & design new collection and containment tools for NASA's Artemis Project.
- PI conceived of ANGSA program (assisted by NM Space Grant) & will lead the efforts of all 9 teams.
- CAAAS team includes NASA & DOE Centers, European Space Agency, & numerous universities.

Team member Harrison Schmitt collecting core sample for this study during Apollo 17 mission



First Core Sample Vacuum Container to be opened, contents examined, and redesigned for future lunar exploration.

CURIOSITY



ChemCam on Curiosity

Horton E. Newsom
Institute of Meteoritics and Dept. of Earth and Planetary Sciences, University of New Mexico
Co-Investigator, NASA ChemCam instrument, and Science Team Member Mars Science Laboratory, Collaborator NASA SuperCam instrument, Mars–2020 rover mission

Statistics:

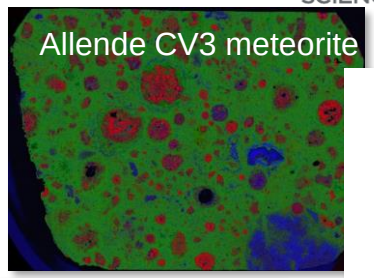
- Seven years operation on Mars
- More than 25 UNM faculty, students and High School interns involved in the project since 2004
- ~ Two million dollars in funding to date to UNM

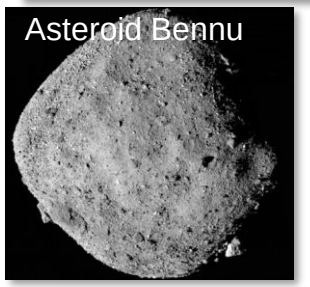
Understanding astrophysical and planetary processes through advanced sample analysis

DEPARTMENT OF EARTH & PLANETARY SCIENCES

Adrian Brearley - Earth and Planetary Sciences

- Origin and evolution of the early solar system through micro and nanoanalytical studies of meteorites. Funding - NASA Cosmochemistry Program
- Behavior of the biogenic elements (C,N,O) and water on small solar system bodies and implications for life on Earth. Funding - NASA Emerging Worlds Program.
- Development of coordinated nanoanalytical techniques for the analysis of samples returned by NASA OSIRIS-Rex (2022) and JAXA Hayabusa2 (2020) asteroid sample return missions. Funding – NASA LARS program.
- Formation of stellar condensates - Analysis of synthetic stellar condensate analogs produced under zero gravity (with Joe Nuth, NASA Goddard) – NASA APRA program.



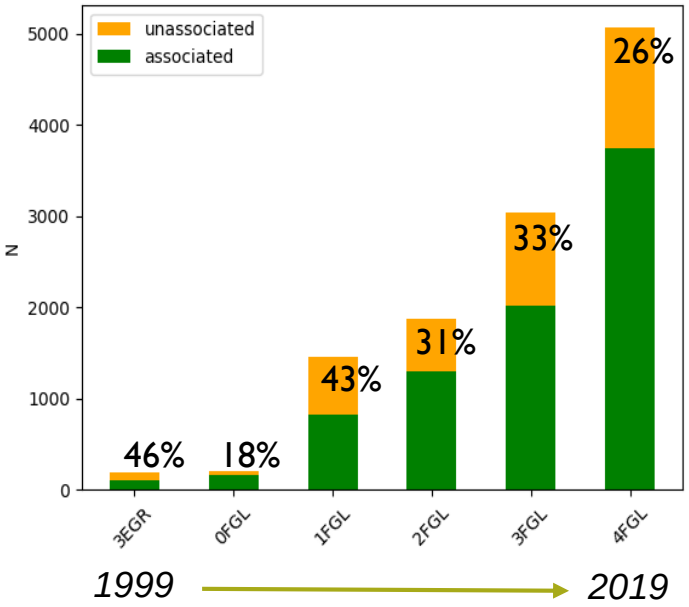


OSIRIS-REx
ASTEROID SAMPLE RETURN MISSION

National Astronomical Observatory of Japan

Radio counterparts to the unexplored γ-ray sky Exoplanets

(Supported through NASA Fermi Guest Investigator Cycles 10 & 11)
(UNM) *P.I. F.K. Schinzel (NRAO/UNM)*



1/4 of the γ -ray sky is unknown after 10 years of *Fermi*! What are we missing?

Since 2013, our radio counterpart searches for active galaxies using NRAO's Very Large Array and Very Long Baseline Array yielded over 400 new associations, the nature of **1323 Fermi identified objects remains unknown**.

Discovery of a γ-ray detected cannonball pulsar and its tail
(joint NASA & NRAO press release)

X-ray follow-up by Chandra X-ray Observatory approved for Cycle 21
P.I. F.K. Schinzel (NRAO/UNM)

Ongoing radio search for γ-ray pulsar counterparts in support of einstein@home.

P.I. D. Dragomir

The Transiting Exoplanet Survey Satellite (TESS) will survey 200,000 of the brightest nearby stars.

Diana Dragomir is starting at UNM this Fall in the Dept. of Physics and Astronomy.

Radiation-hard Detectors of Charged Particles in Space

Sally Seidel, Martin Hoeferkamp

We are developing silicon sensors with high radiation hardness, suitable for space applications. The target tolerance to charged particle fluence is 2E16 n_{eq}/cm^2. These devices implement the transformational 3D technology in which electrodes are perpendicular to silicon wafer surfaces. The present study is aimed at demonstrating the feasibility of charge multiplication (CM) to restore the signal amplitude in thin 3D sensors following intense hadronic exposure. In principle, very small values of inter-electrode distance could mitigate signal loss by enabling charge multiplication before and after irradiation.

The 3D cells are shown in Fig. 1. They have a size of 25×25 μm^2, with a junction column (n^+) at the center and different configurations of ohmic (p^+) columns..

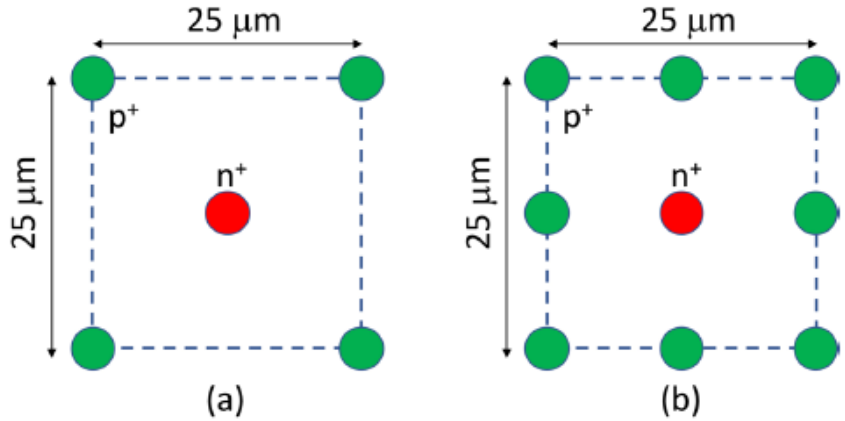


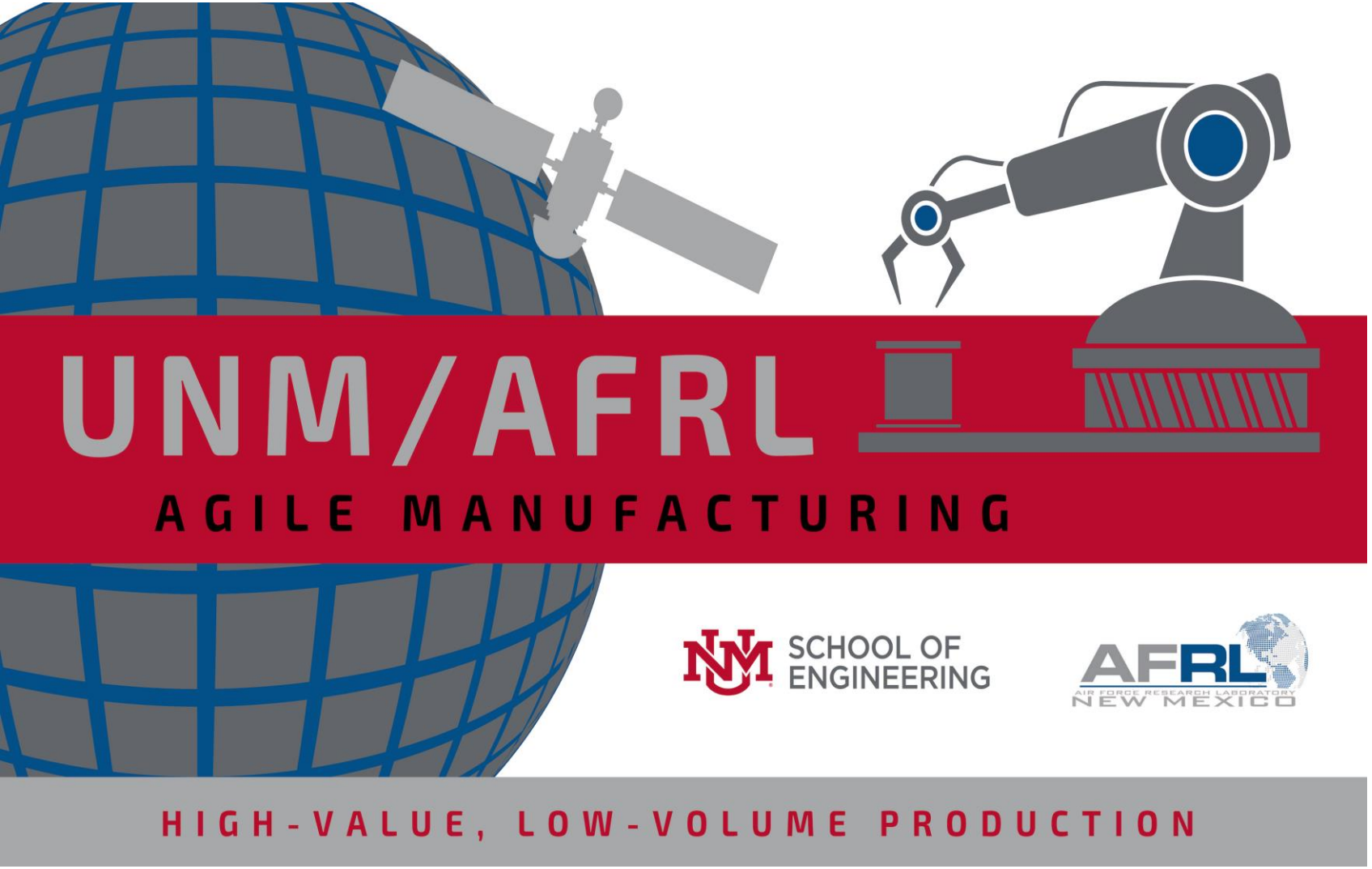
Figure 1. Basic cells of the 3D sensors with charge multiplication by design: (a) 1N-1P, and (b) 1N-3P.

UNM Psychology: Understanding Key Components of Successful Autonomous Space Missions

The major goals of this project are to conduct several ground-based analog missions that simulate work and living conditions during confinement for a long period, social isolation, communication delay with mission control, mission objectives, off-nominal events to a) examine and model the impact of crew autonomy on both the crew and the multi-team systems of crew and mission control, and b) to determine whether its impact changes over time.

PI: Ute Fischer, Georgia Institute of Technology

Co-I: Davood Tofighi, University of New Mexico.

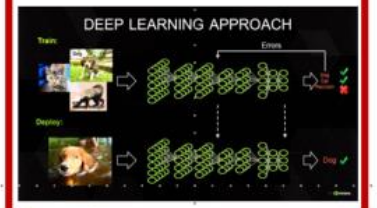


Develop agile manufacturing technologies for small satellite assembly and directed energy systems.

Advance educational partnerships between AFRL and the School of Engineering at UNM.

Enhance local economic impact and development.

Machine Learning
Deep Learning



Multi-material
Additive
Manufacturing

Intelligent
Robotic
Assembly

Machine Vision

Advanced
Manufacturing

BASIC RESEARCH

Agile Manufacturing for High-Value, Low-Volume Production

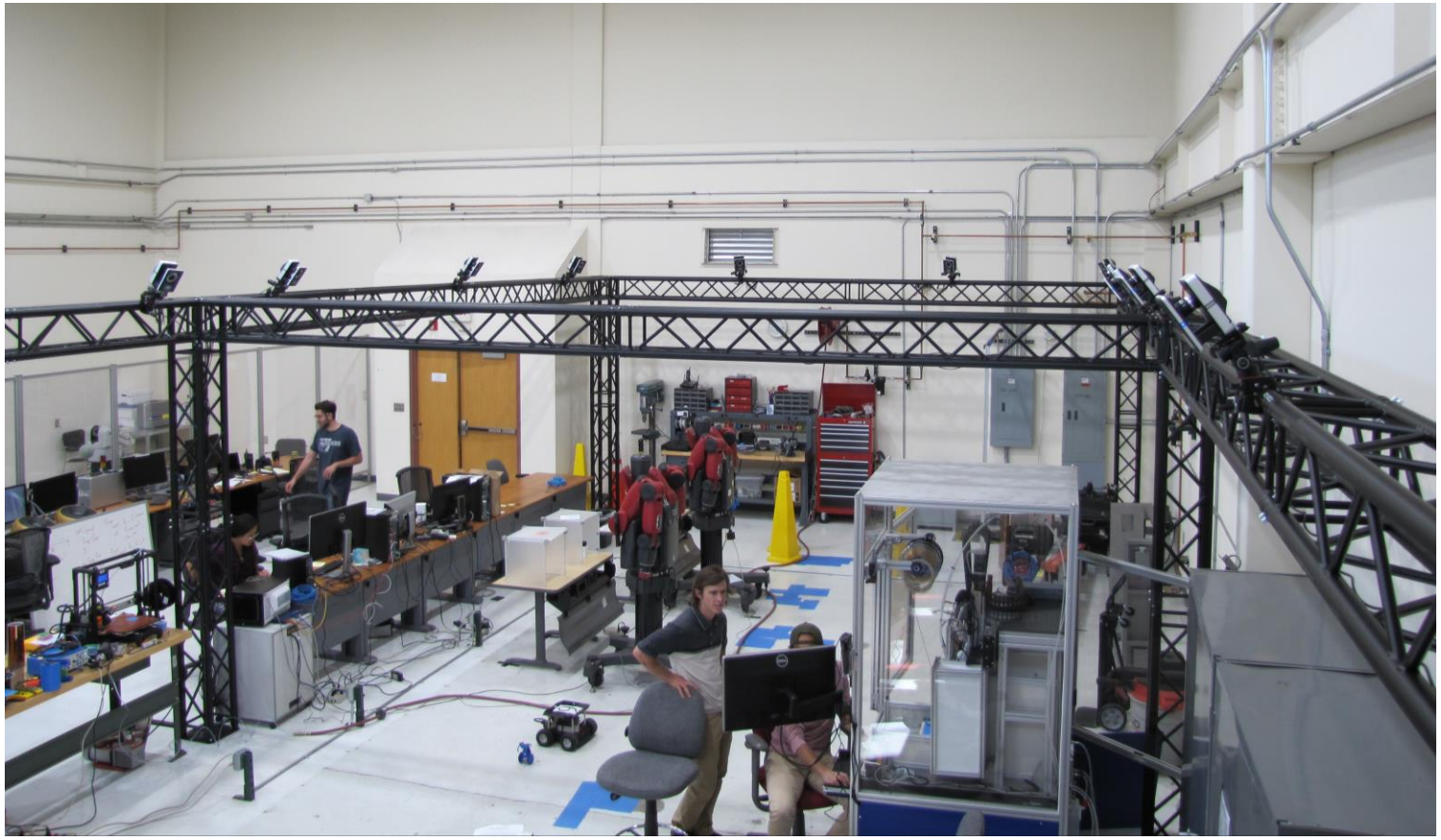
AFRL

PRODUCT

Civil Engineering (CE)	Computer Science (CS)	Electrical & Computer Engineering (ECE)	Mechanical Engineering (ME)
Smart Materials and Structures	Adaptive Motion Planning Machine Learning	Computer Graphics Lab Hybrid Sys & Controls Lab MARHES Lab	Manufacturing Engineering Program ASEMlab

INFRASTRUCTURE

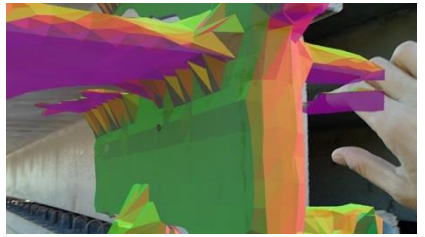
High-performance Computing and Storage Server



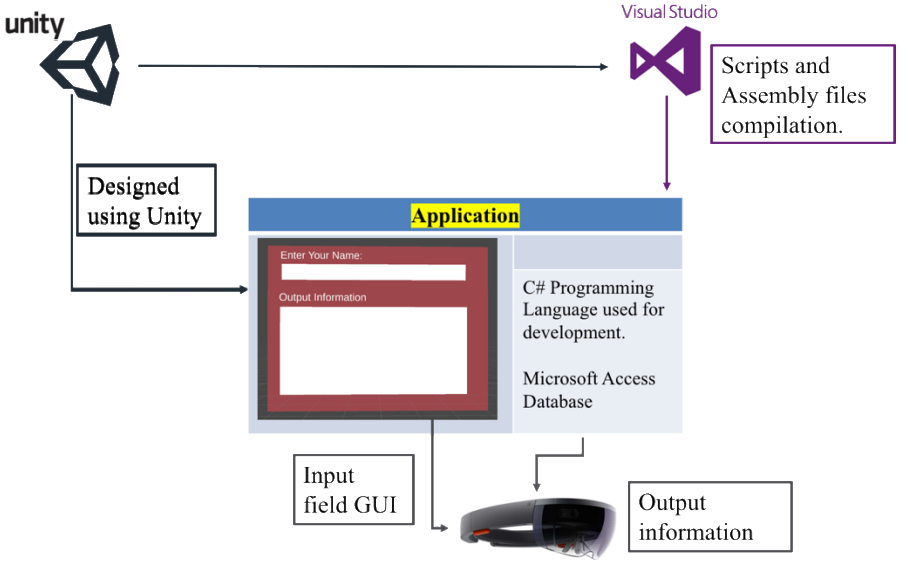
Augmented Reality for Space

Microsoft Hololens

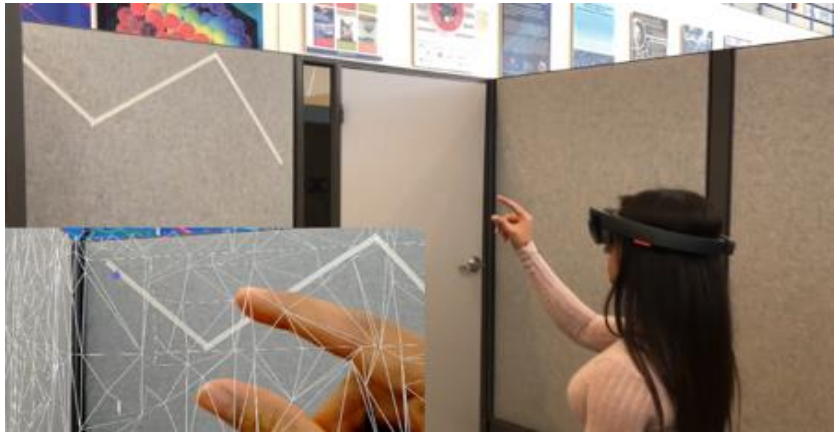
Human Machine Interfaces



Application Architecture



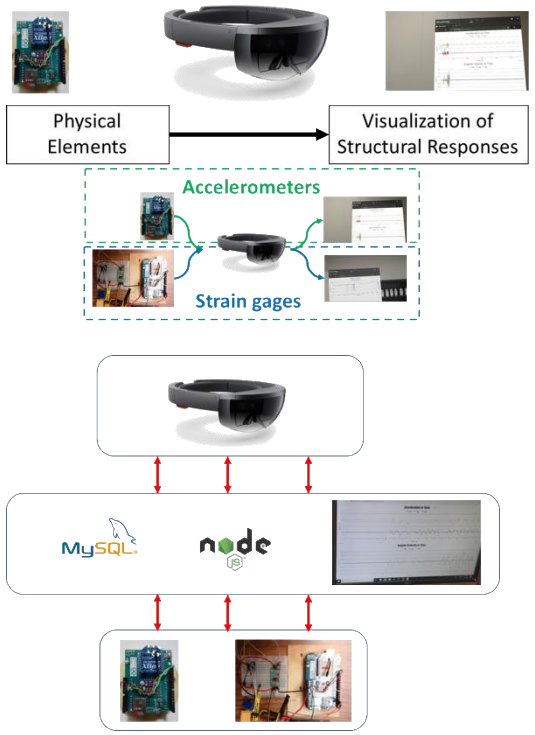
Application Example: Crack Sensing



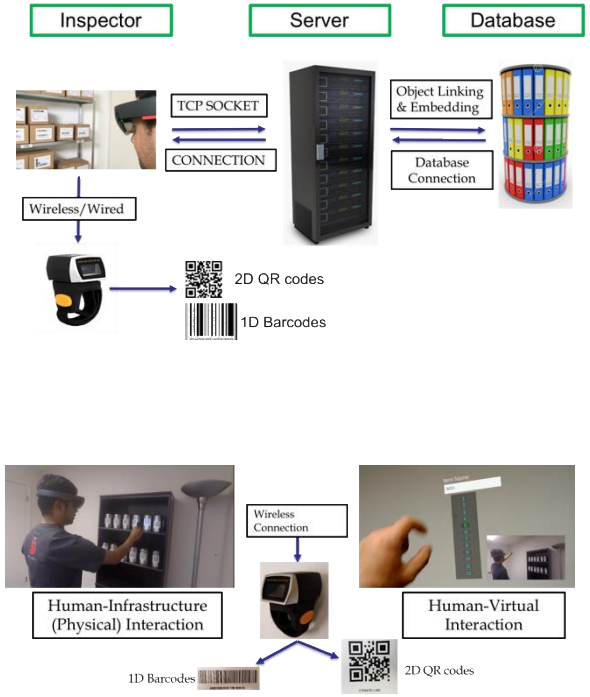
Nine AR applications to date programmed in UNM for Augmented Human Cognition of Engineering Environments

Augmented Reality for Space

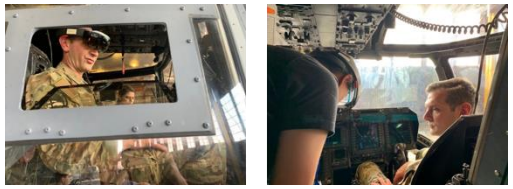
AR and Wireless Sensors Networks



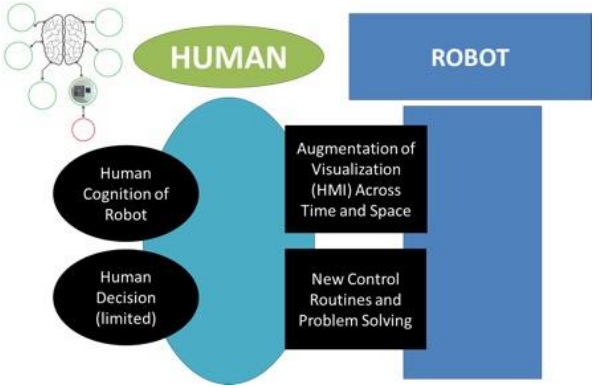
AR and Internet Of Things



AR, Pilots, and Space Operations

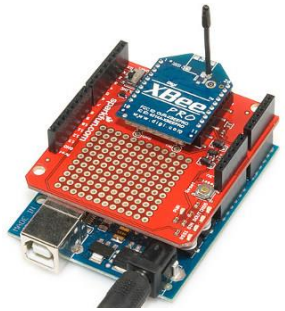


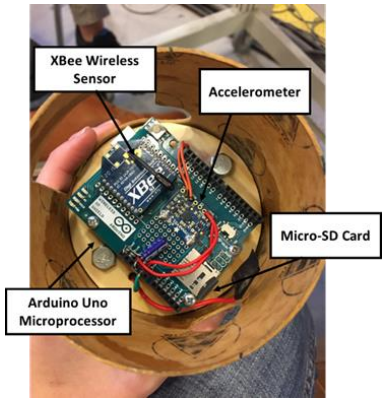
Human-Robotic Interfaces for Space



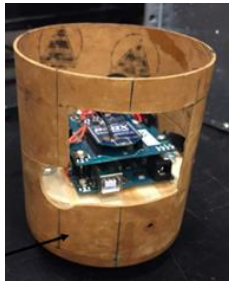
Developing New Human Robotic Interfaces in Space with Augmented Reality in the AFRL UNM Agile Manufacturing Facility

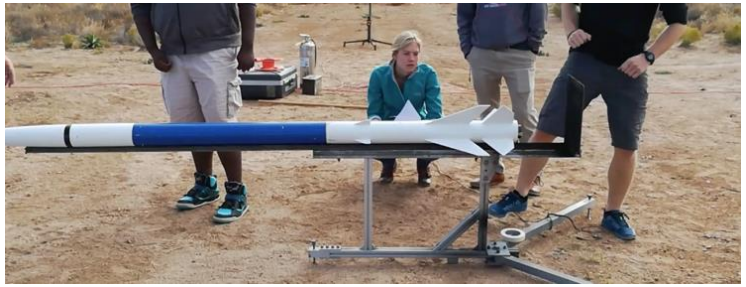
New Wireless Sensors for Structural Health Monitoring (SHM) of Rockets: LEWIS Sensors

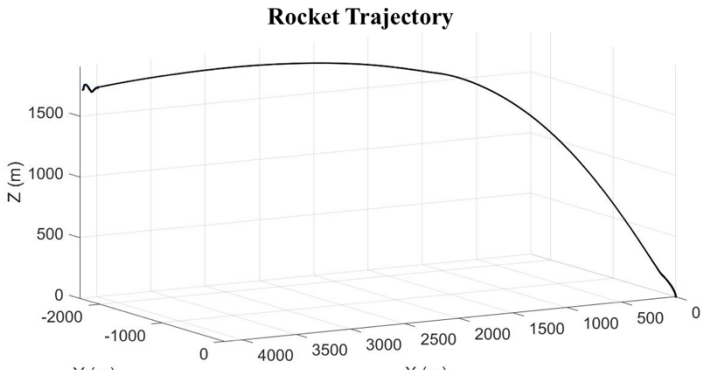




7.4 volt, 1000 mAh Lipo battery







UNM is collaborating with the Albuquerque Rocket Society and The New Mexico Space Grant Consortium to develop the Next Generation of Wireless Smart Sensors for Sensing and SHM of Space Structures

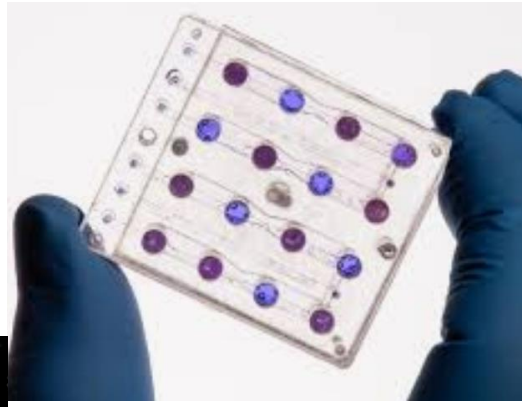
COSMIAC

- Research Center under the School of Engineering at the University of New Mexico
- COSMIAC consists of approximately 60 staff, students, consultants and faculty
- 2018 budget: approx. $10M
- Working with NASA Goddard on radiation effects testing
- Working with NASA Glenn on Communications Systems to include the W/V testbed (a joint Glenn, AFRL and UNM program)
- Working with NASA Ames on nanosatellite activities
- COSMIAC at UNM students are currently working at Ames as summer interns
- Have worked contracts in the past with NASA Headquarters

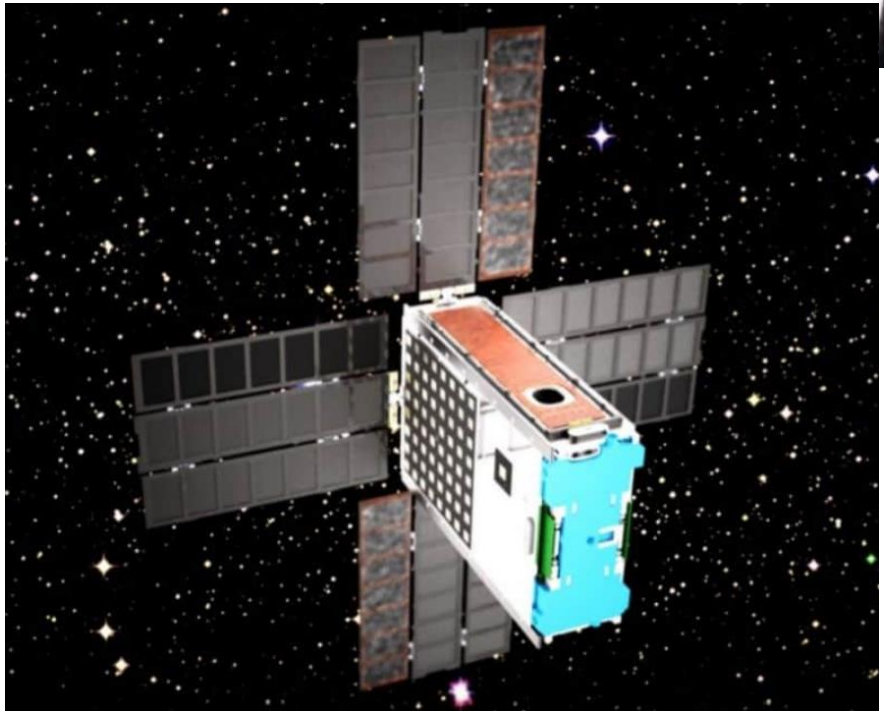
COSMIAC.unm.edu

NASA Space programs – Biosentinal

UNM faculty have been working on the BioSential program for four years under the FILMSS contract



BioSentinel is a planned low-cost CubeSat spacecraft on an space biology mission that will use budding yeast to detect, measure, and compare the impact of deep space radiation on DNA repair over long time beyond low-Earth orbit.

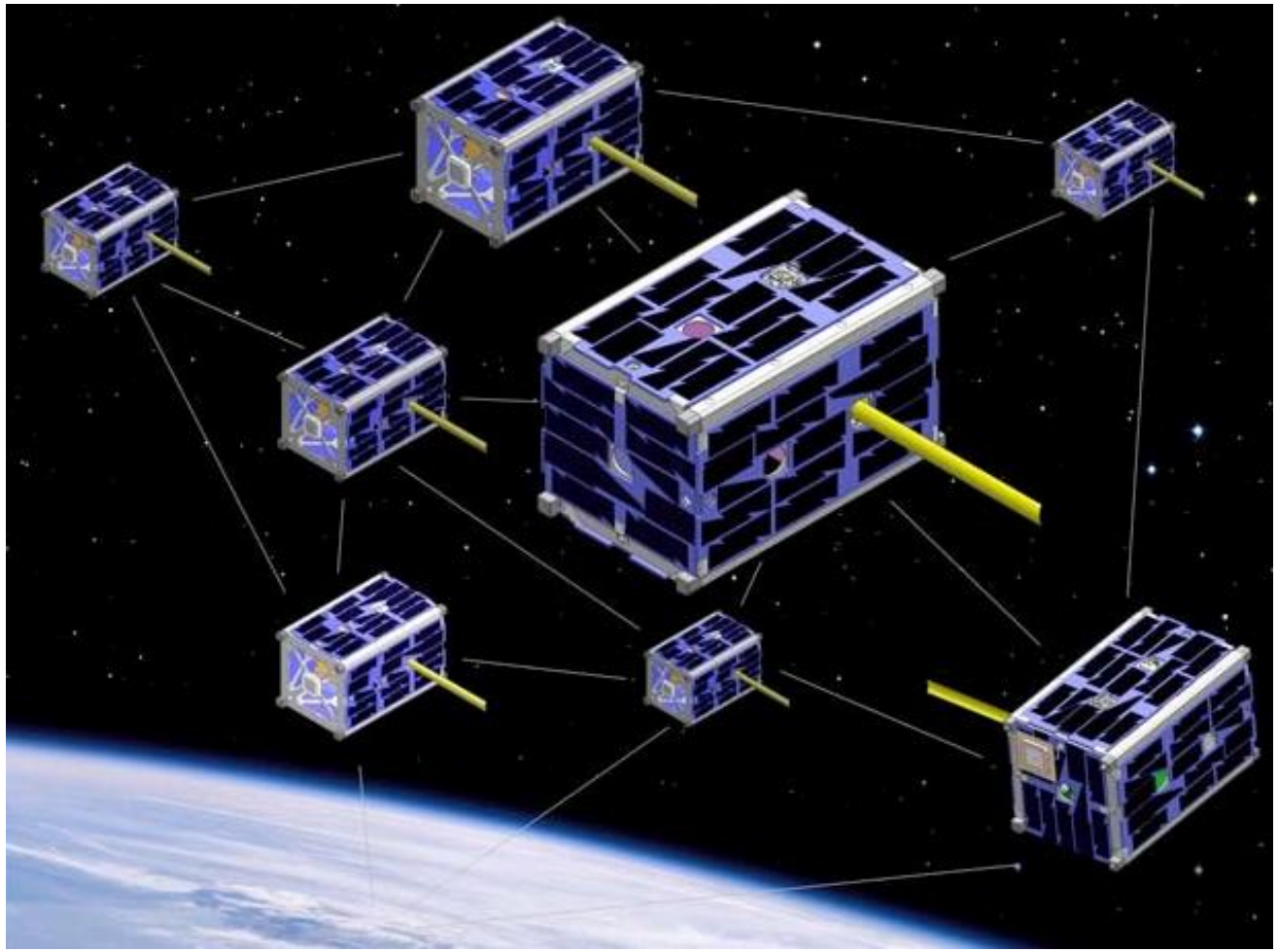


NASA Space programs - WVTL

UNM faculty have been working with NASA Glenn personnel for the past several years on WVTL

In operation since 2015, this 24km link is used to characterize rain attenuation, depolarization, scintillation, and gaseous absorption effects of the atmosphere in the V and W-bands.

Space Applications: Cubesat Swarm (Glenn Center)



Top 100 Worldwide Universities Granted U.S. Utility Patents in 2017

1	UNIVERSITY OF CALIFORNIA, THE REGENTS OF	524
2	MASSACHUSETTS INSTITUTE OF TECHNOLOGY	306
3	UNIVERSITY OF TEXAS	219
4	STANFORD UNIVERSITY	204
5	TSINGHUA UNIVERSITY	176
6	KING FAHD UNIVERSITY OF PETROLEUM AND MINERALS	167
7	JOHNS HOPKINS UNIVERSITY	164
8	WISCONSIN ALUMNI RESEARCH FOUNDATION	162
9	HARVARD COLLEGE, PRESIDENT AND FELLOWS	156
10	CALIFORNIA INSTITUTE OF TECHNOLOGY	150
11	UNIVERSITY OF MICHIGAN	128
12	UNIVERSITY OF SOUTH FLORIDA	116
13	UNIVERSITY OF FLORIDA RESEARCH FOUNDATION, INCORPORATED / UNIVERSITY OF FLORIDA	111
14	NORTHWESTERN UNIVERSITY	106
15	CORNELL UNIVERSITY	102
15	UNIVERSITY OF PENNSYLVANIA	102
17	ARIZONA STATE UNIVERSITY	100
17	PURDUE RESEARCH FOUNDATION	100
19	COLUMBIA UNIVERSITY	98
20	NEW YORK UNIVERSITY	95
21	UNIVERSITY OF PITTSBURGH	94
22	UNIVERSITY OF WASHINGTON	92
23	NATIONAL TSING HUA UNIVERSITY	87
24	UNIVERSITY OF ILLINOIS	85
25	UNIVERSITY OF CHICAGO / UCHICAGO ARGONNE LLC	84
26	UNIVERSITY OF NORTH CAROLINA	82
27	DUKE UNIVERSITY	78
28	KOREA ADVANCED INSTITUTE OF SCIENCE AND TECHNOLOGY	76
29	UNIVERSITY OF MINNESOTA, THE REGENTS OF	75
30	KING SAUD UNIVERSITY	72
31	RESEARCH FOUNDATION OF STATE UNIVERSITY OF NEW YORK	69
32	SCIENCE & TECHNOLOGY CORPORATION AT UNIVERSITY OF NEW MEXICO	67
33	UNIVERSITY OF UTAH RESEARCH FOUNDATION / UNIVERSITY OF UTAH	66
34	KOREA UNIVERSITY RESEARCH AND BUSINESS FOUNDATION	63
35	SUNGKYUNKWAN UNIVERSITY RESEARCH & BUSINESS FOUNDATION	62
36	INDUSTRY-ACADEMIC COOPERATION FOUNDATION YONSEI UNIVERSITY	59
37	RUTGERS UNIVERSITY	57
37	VANDERBILT UNIVERSITY	57
39	TECHNION RESEARCH AND DEVELOPMENT FOUNDATION, LTD.	56
40	CARNEGIE-MELLON UNIVERSITY	55
41	SEOUL NATIONAL UNIVERSITY RESEARCH & DEVELOPMENT BUSINESS FOUNDATION	54
41	UNIVERSITY OF SOUTHERN CALIFORNIA	54
43	CASE WESTERN RESERVE UNIVERSITY	53
43	GEORGIA TECH RESEARCH CORP.	53
45	PENN STATE RESEARCH FOUNDATION, INC.	52
45	POSTECH ACADEMY-INDUSTRY FOUNDATION	52
45	UNIVERSITY OF MASSACHUSETTS	52
48	ÉCOLE POLYTECHNIQUE, FÉDÉRALE DE LAUSANNE	51
48	NATIONAL TAIWAN UNIVERSITY	51
48	UNIVERSITY OF MARYLAND	51
48	YALE UNIVERSITY	51
52	THE UNIVERSITY OF TOKYO	48

THANK YOU